SPRUCE BUDWORM - 1973

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Spruce Budworm Defoliation, Egg-Mass and Damage Surveys on the Superior N.F. - 1973

By

Glen Erickson[1/], Keith Hanson[1/],
A. R. Hastings[2/], and H. V. Toko[3/]

[1/] Forestry Technician, St. Paul Field Office
[2/] Entomology Section Head, St. Paul Field Office
[3/] Field Representative, St. Paul Field Office

INTRODUCTION

The spruce budworm, Choristoneura fumiferana (Clem.) is one of the most important insect pests of spruce-fir forests in North America. The earliest outbreak recorded in Minnesota was the 1911-1926 outbreak when about 20 million cords of balsam fir were estimated killed. The next outbreak occurred from 1954-1963. During this period over 1.5 million cords were killed.

On the Superior National Forest an upsurge of spruce budworm defoliation was detected in 1966 and has continued in varying degrees to the present. This report presents the budworm situation on the Superior National Forest for 1973.

SURVEY OBJECTIVES AND METHODS

Aerial Survey

An aerial survey was flown in early July in cooperation with the Minnesota Department of Natural Resources. Standard sketch mapping methods were used to delineate the infestation boundaries.

Egg-mass and Defoliation Survey

Egg-mass and defoliation surveys were completed in early September. Branch samples were taken from 12 white spruce plots and 54 balsam fir plots. A sample consists of three 15" twigs, taken from mid-crown of three dominant or co-dominant white spruce or balsam fir trees (a total of 9 twigs per plot). Each twig was examined for egg-masses and an estimate made of current defoliation.

Defoliation of each twig was classed as follows:

Class	Current Defoliation
0	0-4%
1	5-25%
2	26-50%
3	51-75%
4	76%

Defoliation of the 9 twigs was then averaged to determine a class for each plot.

The total number of egg-masses was determined for each sample plot.

Damage Survey

The damage survey was made to measure the impact (defoliation, top-kill and mortality) by the budworm on the balsam fir trees in 6 infested stands. Three plots were established in light to moderately defoliated areas, and three plots in heavy to severely defoliated areas with mortality now occurring. A cluster of four 1/10 acre plots were established as shown in Figure 1 to be used for collection of data.

Data were collected to give the land manager information on the number of balsam fir trees per acre in 3 condition classes (live, top-kill and dead) by 4 size classes, and number of balsam fir trees per acre in 4 size classes by defoliation class. All other live tree species were recorded by size class to obtain stand composition.

Size classes were recorded from the following DBH range:

Size class	Inches at DBH
1	1.0-4.9
2	5.0-8.9
3	9.0-14.9
4	15.0+

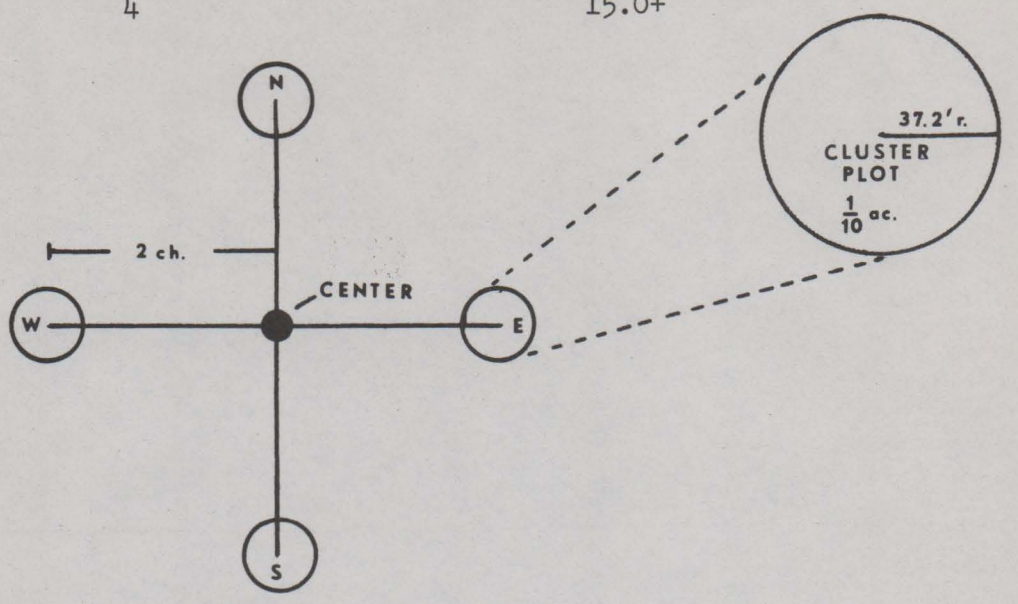


Figure 1. Distribution of plots in a sample cluster used in 1973 damage survey.

The data were obtained from the following locations (Figure 2):

Plot No.	Legal Description			
	T	R	S	¼
1	61N	17W	22	SE
2	59N	10W	12	NE
3	60N	9W	14	SW
4	59N	7W	21	SW
5	60N	6W	24	SW
6	57N	10W	3	SE

RESULTS AND DISCUSSION

The aerial survey indicates 125,000 gross acres with moderate to severe budworm defoliation (Figure 3). Approximately 25% of that acreage can be considered spruce-fir type. Most of the severe defoliation areas are within the main mortality area of 160,000 gross acres, with several small pockets of defoliation scattered throughout the forest.

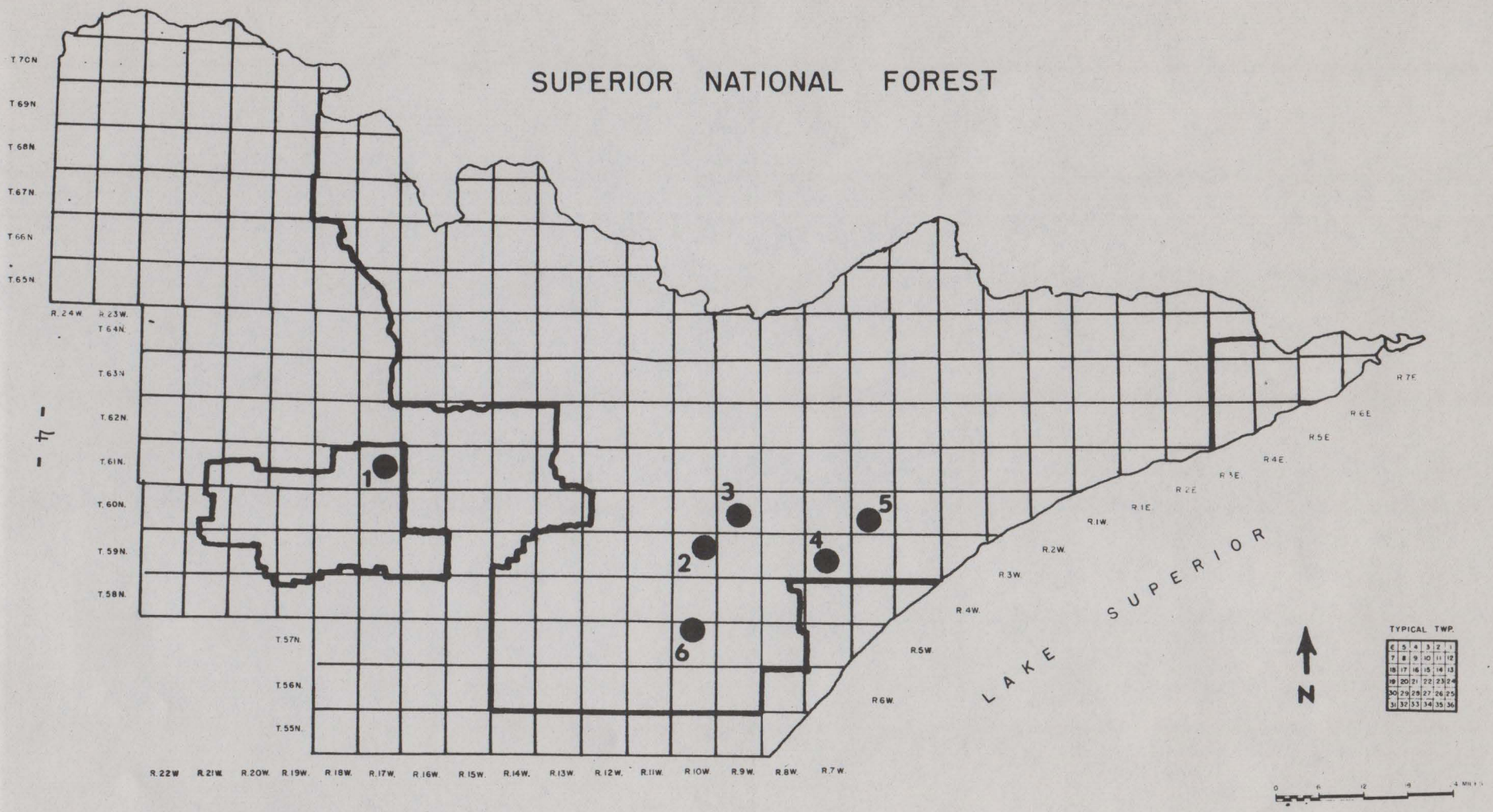


Figure 2. Budworm Damage Survey Plot Locations - 1973

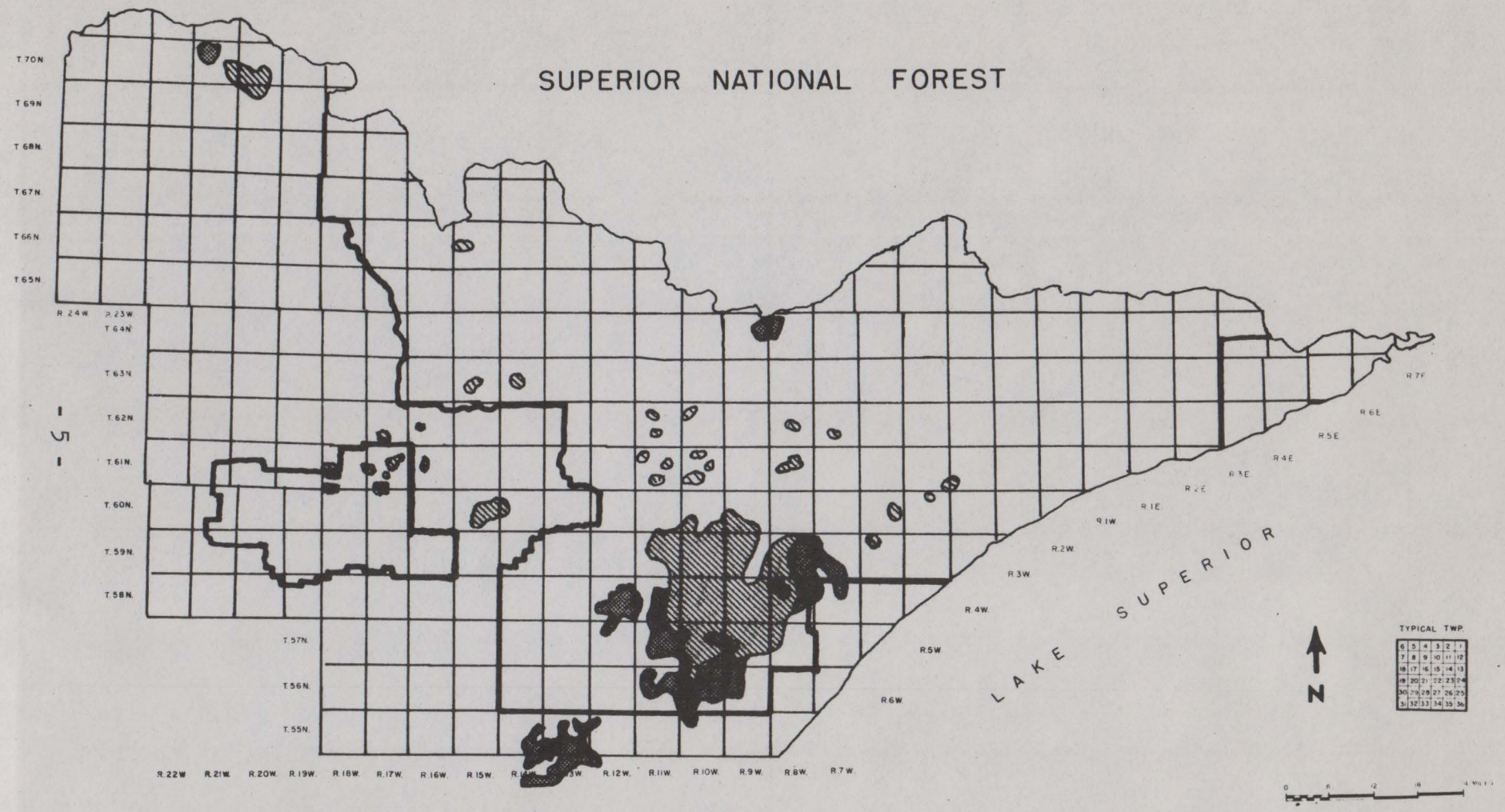


Figure 3. Spruce Budworm Defoliation and Mortality - 1973

Moderate to Severe Defoliation

Mortality

Mortality is mainly confined to an area in the southern portion of the forest where heavy to severe defoliation has occurred for at least four years. Scattered mortality in the northern half of the forest is limited to small pockets.

Egg-mass and Defoliation Survey

Spruce budworm egg-mass data show that none to light defoliation can be expected over most of the areas in 1974 (Figure 4). However, locally heavy defoliation may occur in the southern half of the forest. Egg-mass populations have been on the decrease for the last two years.

The 1973 decline was the most severe, when only one sample plot had a high egg-mass count.

Defoliation estimates for each plot are shown in Figure 5.

White spruce are in no immediate danger in respect to mortality. In three plots the spruce were approximately 50% defoliated for the first time and with a rapidly declining egg population, further defoliation should be minimal.

Damage Survey

Average balsam-fir mortality is 23.3% with a range from 1.4% at plot 5 to 42.9% at plot 6. A majority of the dead trees are in the 1.0-4.9 inch DBH class. All the mortality may not be due to budworm activity alone and no attempt was made to identify the cause. Other causes could be overcrowding, off-side dying, diseases, or other insect (bark beetles and wood borers) damage after trees were under stress from repeated budworm feeding.

Table 1. Summary of balsam fir tree mortality by size class in all plots.

	Size Class (DBH)											
	1.0"-4.9"			5.0"-8.9"			9.0"-14.9"			15.0"+		
Plot No.	Total No. Trees	Dead No.	Dead %	Total No. Trees	Dead No.	Dead %	Total No. Trees	Dead No.	Dead %	Total No. Trees	Dead No.	Dead %
1	144	10	6.9	52	7	13.5	0	0	---	0	0	---
2	64	33	51.6	52	11	21.2	9	2	22.2	0	0	---
3	70	3	4.3	19	1	5.3	0	0	---	0	0	---
4	161	65	40.4	60	3	5.0	0	0	---	0	0	---
5	48	1	2.1	23	0	---	1	0	---	0	0	---
6	113	54	47.8	28	8	28.6	0	0	---	1	1	100.0
Totals	600	166	27.7	244	30	12.3	10	2	20.2	1	1	100.0

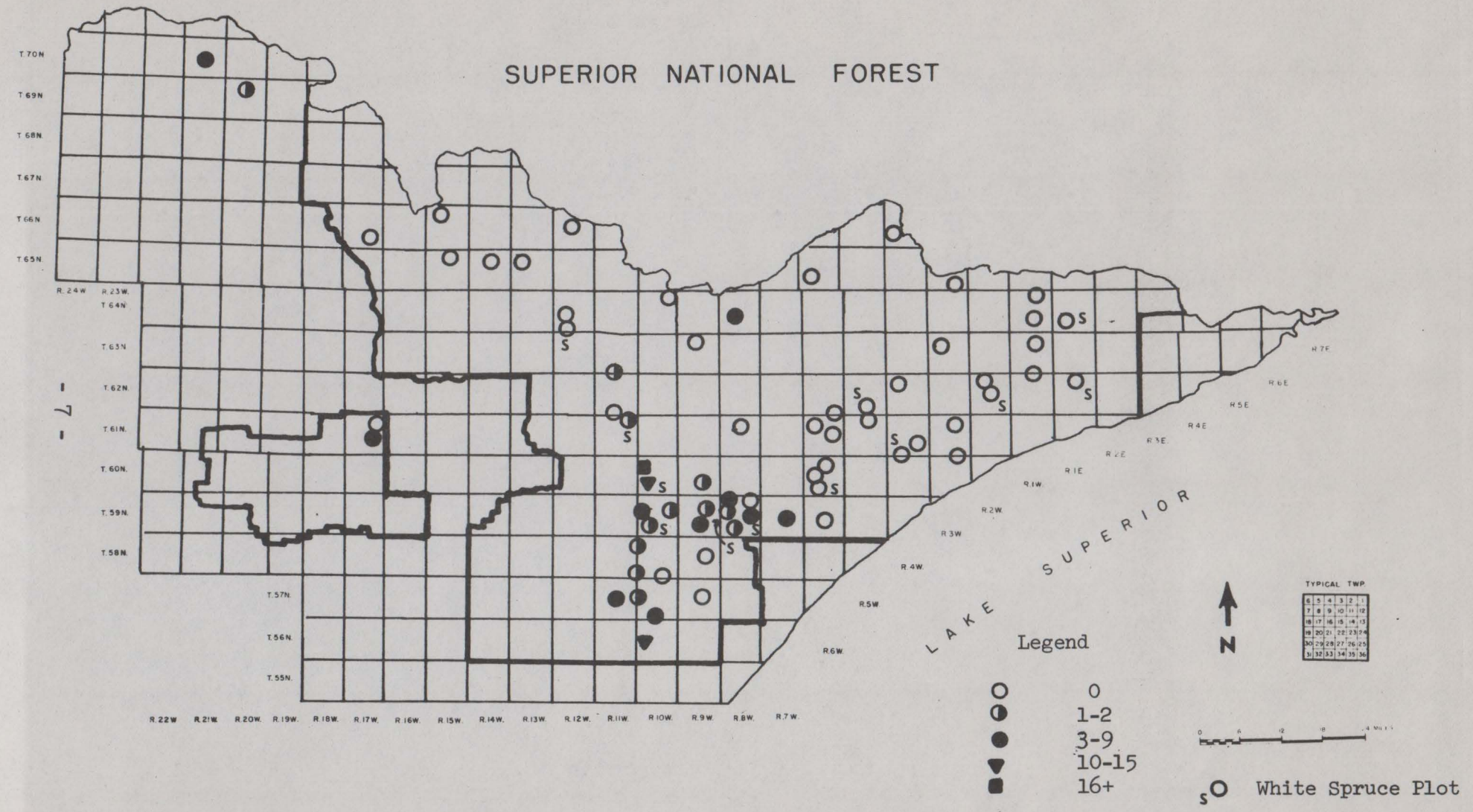


Figure 4. Spruce Budworm Egg-mass Counts By Plot Location - 1973

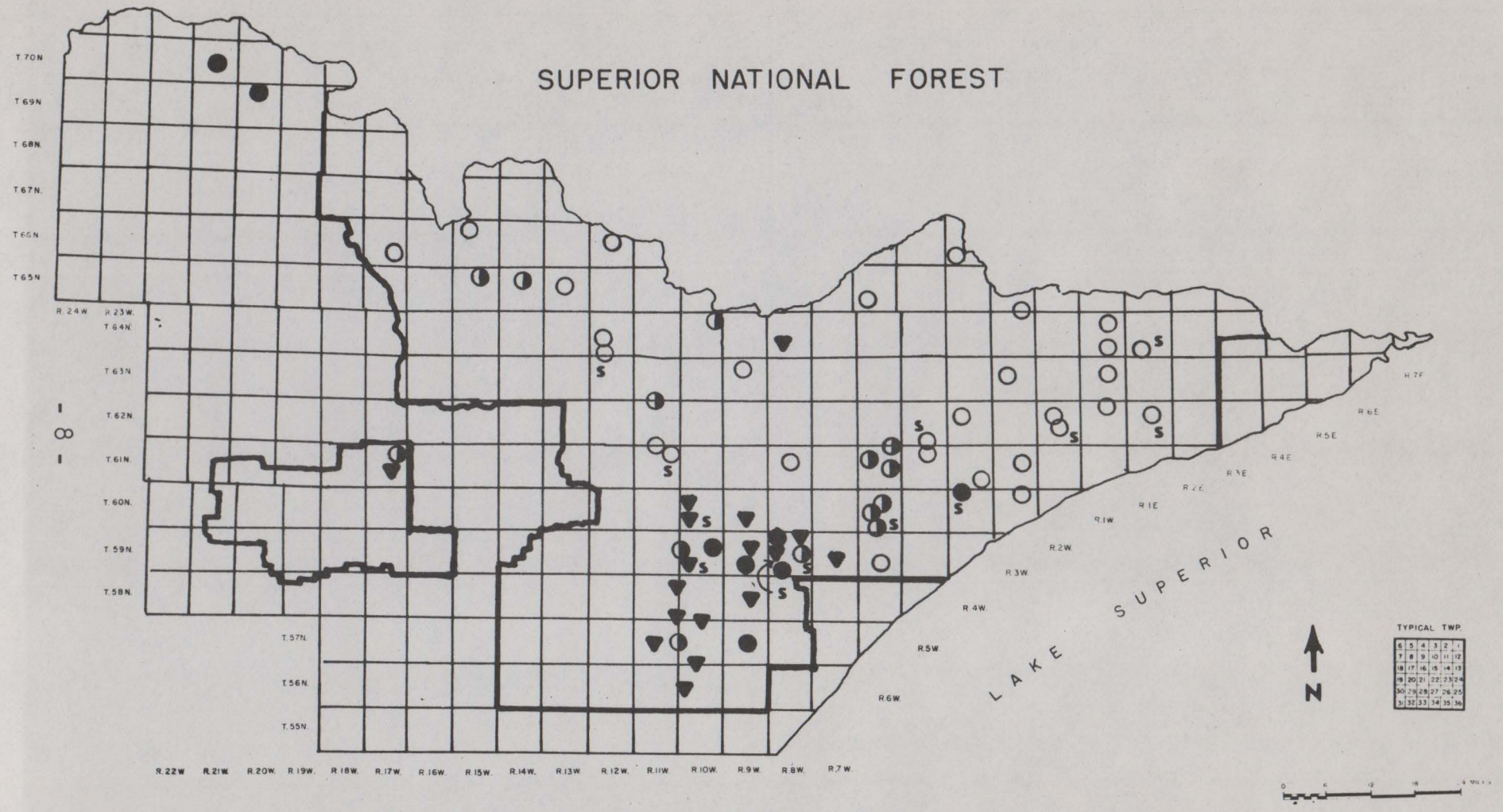


Figure 5. Spruce Budworm Defoliation By Plot Locations - 1973

$_{S}$O - White spruce plot

O None
◑ 5-25%
● 26-50%
▼ 51-75%
■ 76% +

CONCLUSION

The effects of balsam fir mortality are primarily on visual impact. Since most of the dead trees are in the smaller size classes which are already abundant in the area, the immediate concern is not great. However, the current losses may reduce future supply of larger trees.

Additional mortality of balsam fir can be expected from the top-killed and severely defoliated class of trees. The land manager should evaluate the areas of future mortality to determine if salvage cutting is needed.

Egg-mass survey data suggest reduced defoliation in 1974. The spruce budworm outbreak is on a decline, but few locally severe defoliations are expected.

RECOMMENDATION

The following surveys are recommended for 1974 to determine:

1. Progression of tree mortality.

2. Extent of balsam-fir defoliation.

3. Egg-mass survey to predict budworm population trend.

The land managers have already been advised of the fir mortality situation and salvage sales are being considered.

Appendix

Summary of balsam fir tree conditions by size class for plot 1.

Tree Condition	Trees Total Number	Tree Size Class[1/] 1 No.	2 No.	3 No.	4 No.	Trees/ acre
Live	169	125	44	0	0	422.5
Dead	17	10	7	0	0	42.5
Top Kill	10	9	1	0	0	25.0
Totals	196	144	52	0	0	490.0

1/ See explanation of size classes page 3.

Summary of balsam fir defoliation by size class for plot 1.

Size Class	Total	Defoliation Class[2/] 0 No.	1 No.	2 No.	3 No.	4 No.
1	134	110	20	3	1	0
2	45	22	15	7	1	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
Totals	179	132	35	10	2	0

2/ See explanation of defoliation classes page 2.

Summary of number of live trees by species and size class for plot 1.

Tree Species	Total Number	Size Class 1 No.	2 No.	3 No.	4 No.	Trees/ Acre
Balsam Fir	179	134	45	0	0	447.5
Red Pine	1	0	0	0	1	2.5
Jack Pine	2	0	0	2	0	5.0
Aspen	26	5	16	5	0	65.0
Birch	50	26	22	2	0	125.0
Totals	258	165	83	9	1	645.0

Summary of balsam fir tree conditions by size class for plot 2.

Tree Condition	Trees Total Number	Tree Size Class 1 No.	2 No.	3 No.	4 No.	Trees/ acre
Live	79	30	41	7	1	197.5
Dead	46	33	11	2	0	115.0
Top Kill	1	1	0	0	0	2.5
Totals	126	64	52	9	1	315.0

Summary of balsam fir defoliation by size class for plot 2.

Size Class	Total	Defoliation Class 0 No.	1 No.	2 No.	3 No.	4 No.
1	31	5	13	4	7	2
2	41	1	9	12	12	7
3	7	0	0	2	5	0
4	1	0	0	0	1	0
Totals	80	6	22	18	25	9

Summary of number of live trees by species and size class for plot 2.

Tree Species	Total Number	Size Class 1 No.	2 No.	3 No.	4 No.	Trees/ Acre
Balsam Fir	80	31	41	7	1	200.0
W. Spruce	4	0	1	1	2	10.0
Black Spruce	2	0	1	1	0	5.0
Cedar	3	0	1	2	0	7.5
Aspen	8	0	0	3	5	20.0
Birch	21	10	8	2	1	52.5
Totals	118	41	52	16	9	295.0

Summary of balsam fir tree conditions by size class for plot 3.

Tree Condition	Trees Total Number	Tree Size Class 1 No.	2 No.	3 No.	4 No.	Trees/ Acre
Live	76	59	12	5	0	190.0
Dead	4	3	1	0	0	10.0
Top Kill	17	8	6	3	0	42.5
Totals	97	70	19	8	0	242.5

Summary of balsam fir defoliation by size class for plot 3.

Size Class	Total	Defoliation Class 0 No.	1 No.	2 No.	3 No.	4 No.
1	67	3	25	16	17	6
2	18	0	4	1	6	7
3	8	0	0	1	0	7
4	0	0	0	0	0	0
Totals	93	3	29	18	23	20

Summary of number of live trees by species and size class for plot 3.

Tree Species	Total Number	Size Class 1 No.	2 No.	3 No.	4 No.	Trees/ Acre
Balsam fir	93	67	18	8	0	232.5
Black spruce	23	19	3	1	0	57.5
Jack Pine	7	2	2	3	0	17.5
Red Pine	38	28	8	2	0	95.0
Aspen	31	26	5	0	0	77.5
Birch	1	0	0	1	0	2.5
Totals	193	142	36	15	0	482.5

Summary of balsam fir conditions by size class for plot 4.

Tree Condition	Trees Total Number	Tree Size Class 1 No.	2 No.	3 No.	4 No.	Trees/ Acre
Live	127	74	48	5	0	317.5
Dead	68	65	3	0	0	170.0
Top Kill	31	22	9	0	0	77.5
Totals	226	161	60	5	0	565.0

Summary of balsam fir defoliation by size class for plot 4.

Size Class	Total	Defoliation Class 0 No.	1 No.	2 No.	3 No.	4 No.
1	96	6	19	18	31	32
2	57	0	1	18	25	13
3	5	0	1	2	2	0
4	0	0	0	0	0	0
Totals	158	6	21	38	58	45

Summary of number of live trees by species and size class for plot 4.

Tree Species	Total Number	Size Class 1 No.	2 No.	3 No.	4 No.	Trees/ Acre
Balsam Fir	158	96	57	5	0	395.0
Cedar	24	15	6	2	1	60.0
Birch	9	1	3	3	2	22.5
Ash	3	1	2	0	0	7.5
Totals	194	113	68	10	3	485.0

Summary of balsam fir tree conditions by size class for plot 5.

Tree Condition	Trees Total Number	Tree Size Class 1 No.	2 No.	3 No.	4 No.	Trees/ Acre
Live	71	47	23	1	0	177.5
Dead	1	1	0	0	0	2.5
Top Kill	0	0	0	0	0	0.0
Totals	72	48	23	1	0	180.0

Summary of balsam fir defoliation by size class for plot 5.

Size Class	Total	Defoliation Class 0 No.	1 No.	2 No.	3 No.	4 No.
1	47	21	22	4	0	0
2	23	9	11	3	0	0
3	1	0	0	1	0	0
4	0	0	0	0	0	0
Totals	71	30	33	8	0	0

Summary of number of live trees by species and size class for plot 5.

Tree Species	Total Number	Size Class 1 No.	2 No.	3 No.	4 No.	Trees/ Acre
Balsam Fir	71	40	23	1	0	177.5
Aspen	53	21	23	10	0	132.5
Birch	6	4	1	1	0	15.0
Maple	4	3	1	0	0	10.0
Totals	134	68	48	12	0	335.0

Summary of balsam fir tree conditions by size class for plot 6.

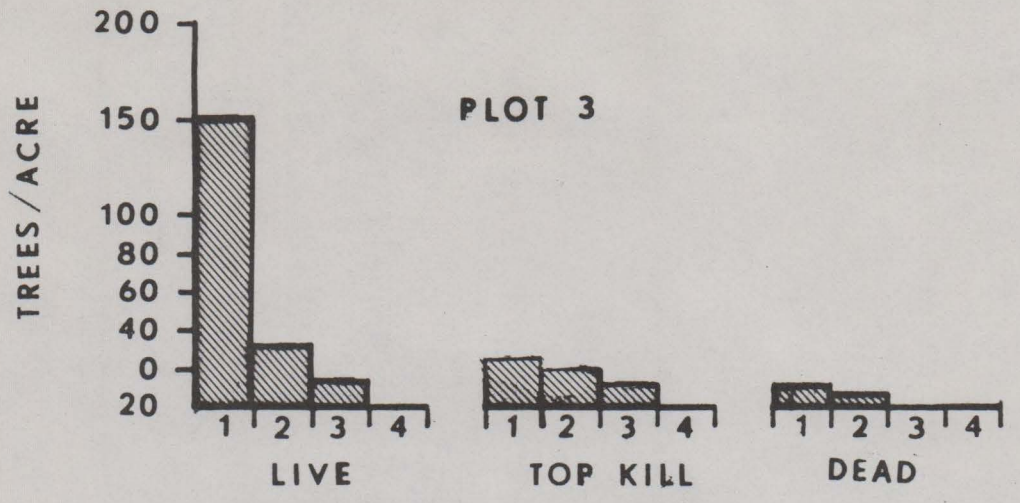
Tree Condition	Trees Total Number	Tree Size Class 1 No.	2 No.	3 No.	4 No.	Trees/ Acre
Live	77	54	19	4	0	192.5
Dead	63	54	8	0	1	157.5
Top Kill	7	5	1	1	0	17.5
Totals	147	113	28	5	1	367.5

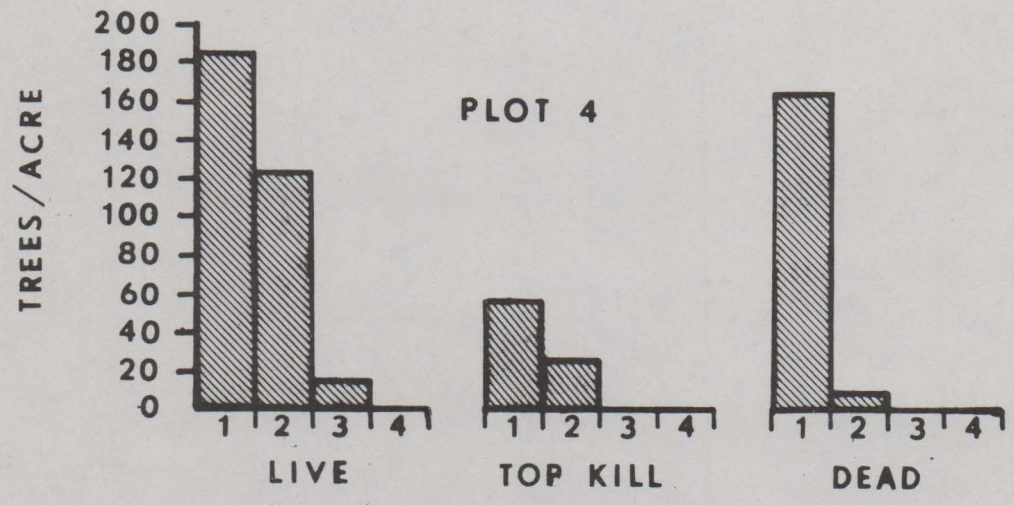
Summary of balsam fir defoliation by size class for plot 6.

Size Class	Total	Defoliation Class 0 No.	1 No.	2 No.	3 No.	4 No.
1	59	22	19	6	7	5
2	20	1	2	4	10	3
3	5	0	0	1	1	3
4	0	0	0	0	0	0
Totals	84	23	21	11	18	11

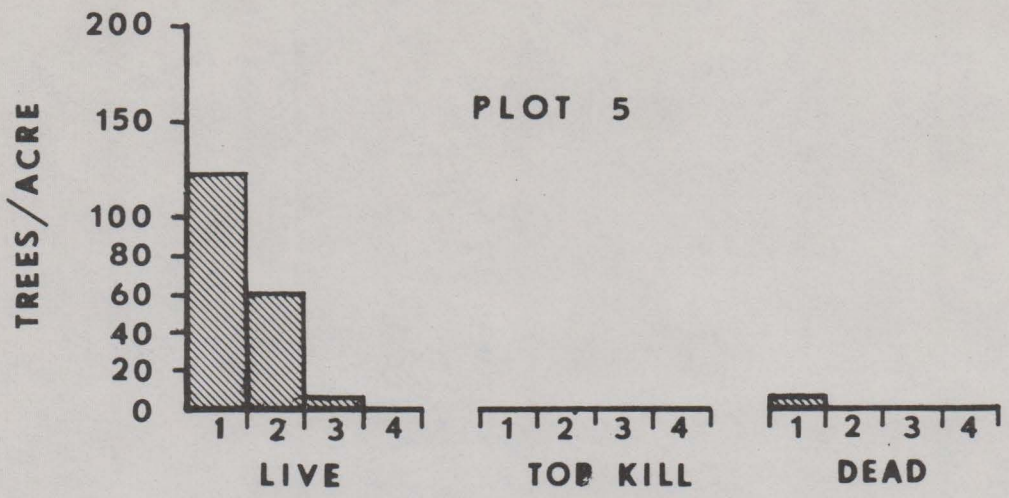
Summary of number of live trees by species and size class for plot 6.

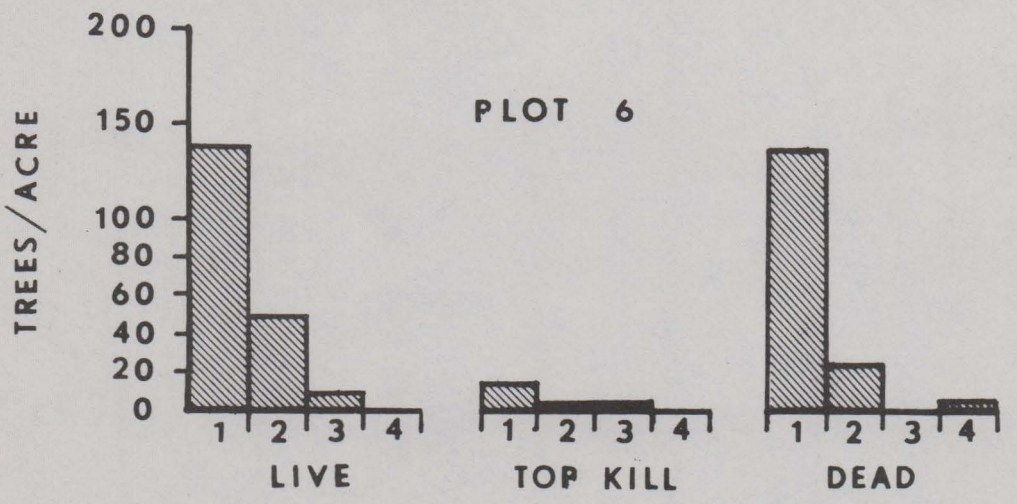
Tree Species	Total Number	Size Class 1 No.	2 No.	3 No.	4 No.	Trees/ Acre
Balsam Fir	84	59	20	5	0	210.0
Black Spruce	29	6	19	4	0	72.5
Birch	11	0	1	6	4	27.5
Ash	2	1	1	0	0	5.0
Totals	126	66	41	15	4	315.0



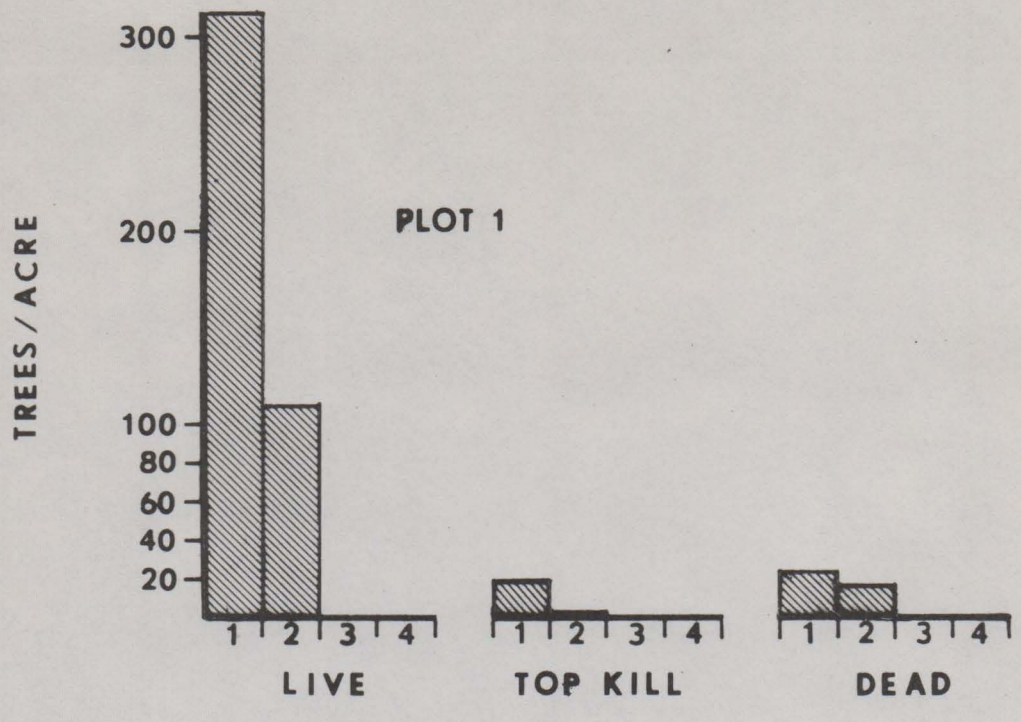


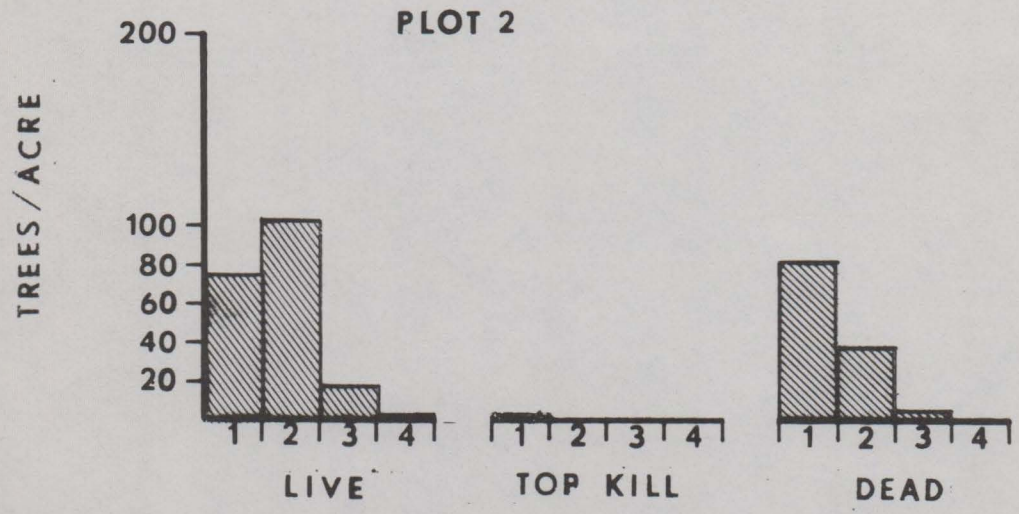
Balsam fir trees per acre by tree condition and size class for plots 3 and 4.



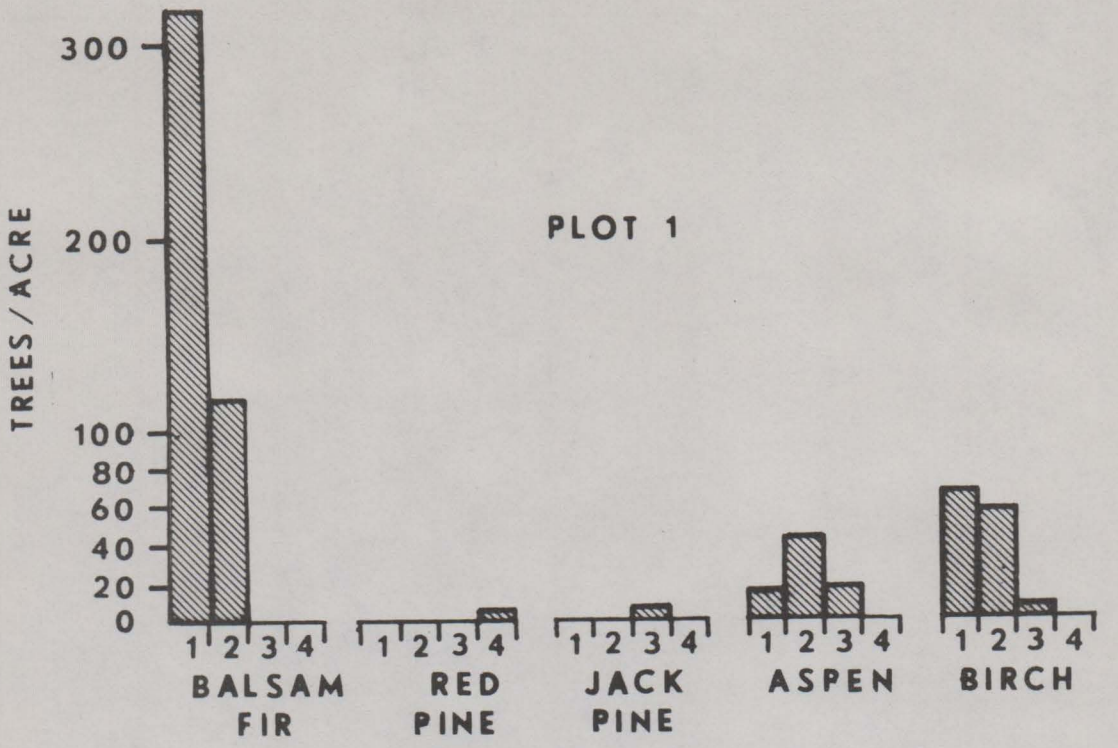


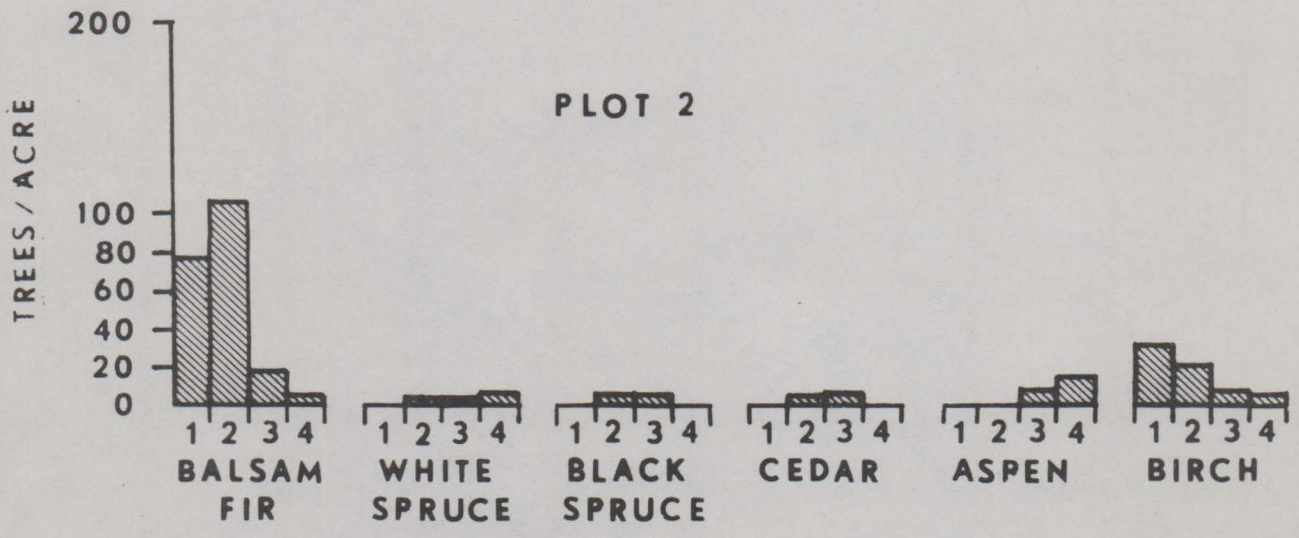
Balsam fir trees per acre by tree condition and size class for plots 5 and 6.



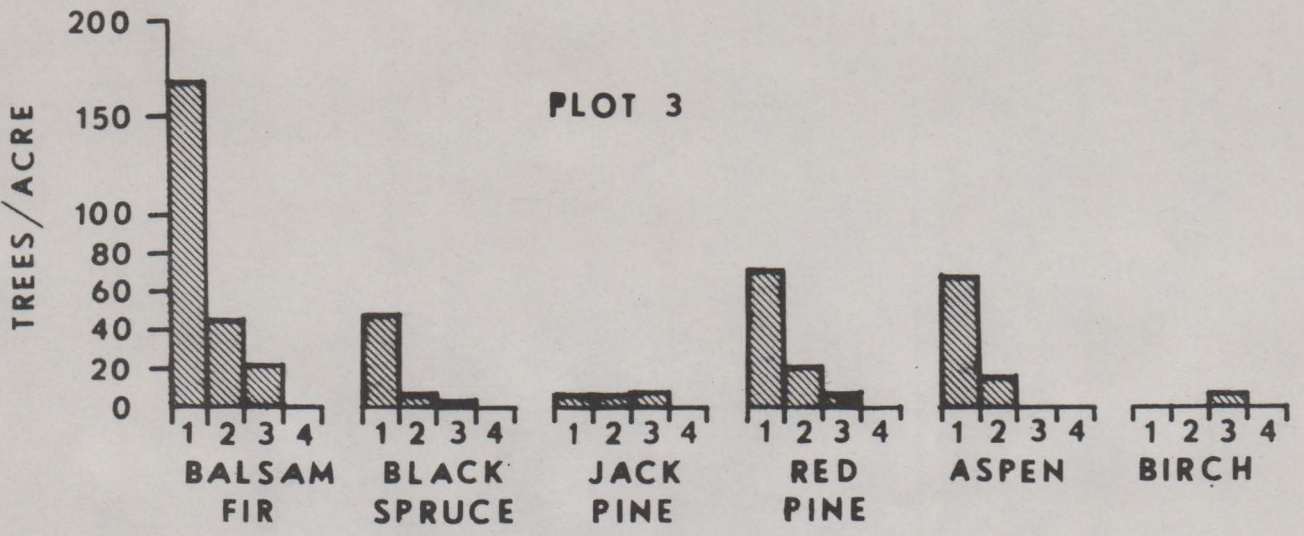


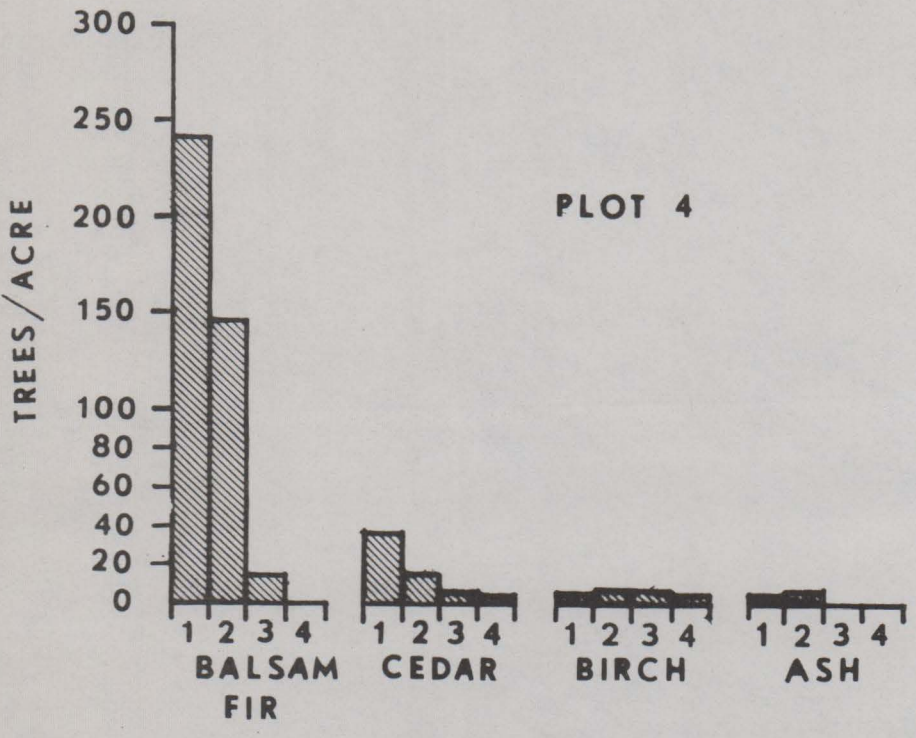
Balsam fir trees per acre by tree condition and size class for plots 1 and 2.



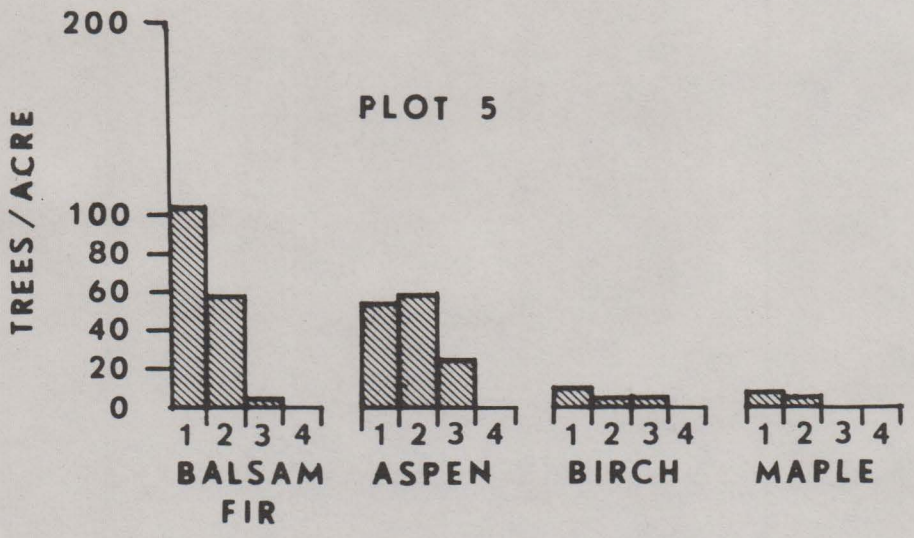


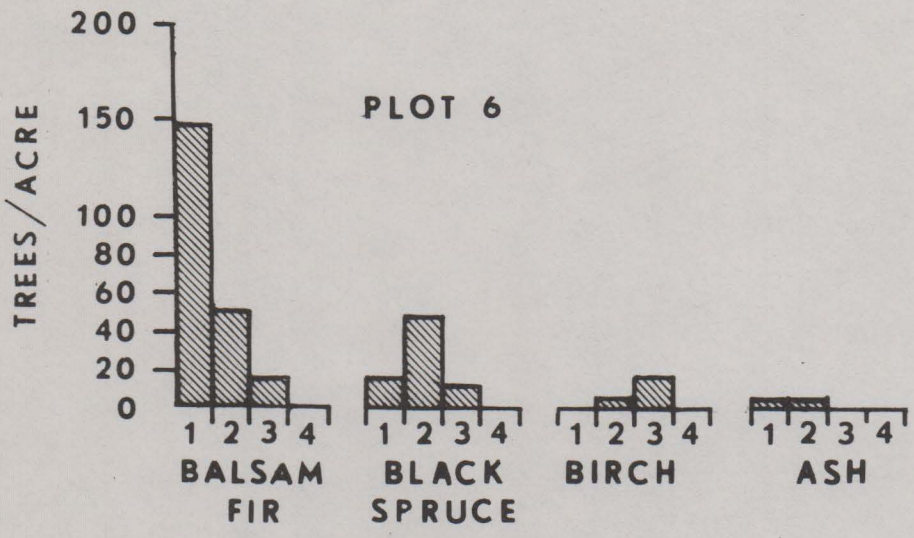
Trees per acre by each species and size class for plots 1 and 2.





Trees per acre by each species and size class for plots 3 and 4.





Trees per acre by each species and size class for plots 5 and 6.